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A Study of Pulsating Feeders for Molten Glass

By ROY E. SWAIN[1]

WITH the development of the press there was evolved new type of glass worker, the punty gatherer. This man's work was similar to "bit" gathering but opened up many new possibilities for the development of skill. Then with the coming of the semiautomatic bottle machines another branch of punty gathering was developed that demanded skill in speed, shape and weight to a degree never before required.

It is necessary to gather the molten glass in proper shape in order to get the glass into the narrow mouth blanks, prevent entrapping air between the glass and the blank mold, entrapping air in the glass, or the formation of laps. The gathering that just fits the blank mold has the advantage of receiving a skin of equal thickness throughout as every part of the surface comes in contact with the blanket mold at the same instant. This uniform thickness of skin is a great advantage in obtaining a uniform distribution of glass in the finished article.

The good gatherer is one who can so shape his glass that it goes solidly into the blank mold, who judges his weight so that the article comes within the specifications, and has speed enough to get the maximum production out of the machine.

Many attempts have been made to develop machines to manipulate the punty and thus do away with the gatherer and one or two of these were able to deliver glass to molds, but they required too much attention to become commercially successful.

Flowing devices were set up. A flowing device consisted of a freely flowing stream of glass and a severing means. Forming machines had been developed for hand gatherers which had not the speed to handle the glass from such an arrangement, so cups were brought into use to collect and shape the glass that accumulated while the forming machine was being indexed.

Glass caught in these cups is irregularly and unduly chilled causing blemishes in the finished ware. This caused the experimenters to look about for ways of interrupting the flow of glass from above the orifice so that the surface of the depending glass would be untouched. Many methods have been devised for creating these pulsations but the most popular have been the reciprocating needle, the paddle, and the pneumatic.

A means for creating pulsations in a stream of glass and a device for severing the depending gobs constitutes a feeder of the simplest form, which in the hands of a good operator may be made to do excellent work in a limited field Glasshouse conditions vary greatly as also do feeder requirements, so one finds that a great many improvements have been worked out to increase the range and flexibility of the feeder.

If the feeder is divided into its different parts or functions and these parts studied separately we may then be better able to judge the feeder as a whole, whether it be for the purpose of designing a new feeder or the selection of a feeder for purchase.

Homer Brooke was one of the first to work on flowing devices and his U. S. patent No. 588,318 discloses a siphon shown as a curved or jointed tube for flowing glass from a pot or tank. The siphon is also shown in No. 1,382,994 and No. 1,514,091 issued to Clide R. Lott. The possibility of the siphon being used is so remote that it need be given no further consideration.

The spout or extending tube was also prominent in the plicated than the siphon but it is doubtful if they will ever early feeder study and experimentation. These are less complicated than the siphon but it is doubtful if they will ever compete with the forehearth in bringing the molten glass out from the tank to the machine.

The forehearth or boot is a smaller compartment built onto the melting tank. The floor of the forehearth is a few inches below the metal line of the tank. In the floor is provided an orifice through which the glass flows. In November, 1901, H. M. Brookfield made application for a patent later granted as No. 836,297 that show the essentials of such a forehearth.

The auxiliary pot that is filled by gravity or some mechanical feeding device might be considered at this point. The complication of parts does not seem justified and no doubt it will give way to the forehearth, for in feeders, as in all other glass working equipment, simplicity and sturdiness are very desirable.

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In this study of the development of the feeder the dates of inventions will not always be the governing factor in the selection of the models but typical parts will be presented to show certain advantages of types.

In Fig. 1 is shown a number of forehearths including what may be taken as a typical or accepted conventional forehearth, (A), taken from Fig. 2 of U. S. patent No.

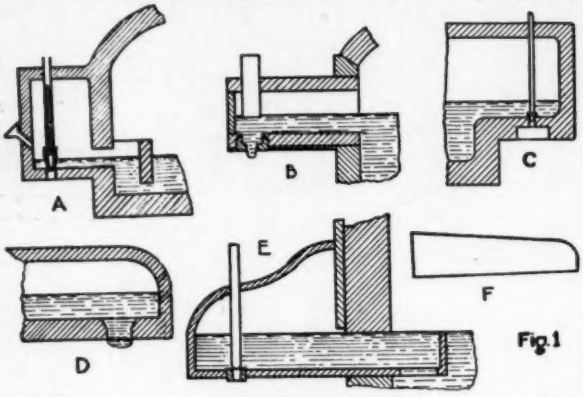

Fig. 1

836,297 to H. M. Brookfield showing a simple rectangular shape without giving any unnecessary details of construction. (B) From George E. Cleveland's U. S. patent No. 901,881 shows a rectangular structure with some of the details of construction. (C) From U. S. patent No. 1,047,731 to Charles E. Blue shows a very common type consisting of an off-set in the furnace. (D) From U. S. patent No. 1,143,317 to L. W. Proeger gets away from the rectangular lines. (E) From U. S. patent No. 1,151,393 to John Rau is a little more elaborate. (F) From U. S. patent No. 1,497,929 shows a very simple outline that would be recognized as a forehearth by any one familiar with present day glasshouse equipment.

The forehearth is not only required to bring the glass out from the furnace a distance great enough to provide room for the feeder mechanism and the forming machine but may also be required to condition the glass for the forming machine as a plant making a variety of wares may have two adjacent machines one of which requires hot glass and

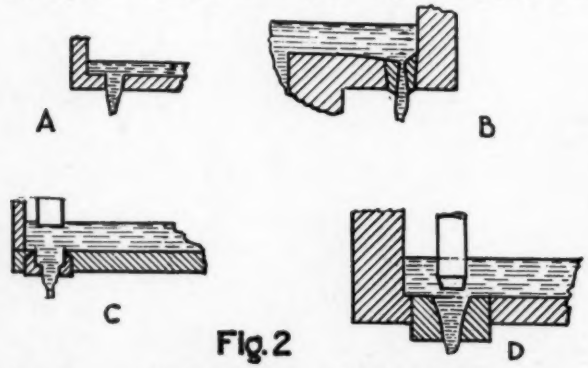

Fig. 2

the other a relatively cold glass. Tank conditions will vary as also will the working character of the glass. The forehearth should have a volume sufficient to give time to this conditioning without having to force the glass to a point that would be detrimental to its quality or working properties.

Among the early forehearth drawings we find that only a simple orifice is provided of the size considered necessary for the work to be performed. This meant the changing of the forehearth when the orifice became worn or a different size orifice was required, so we soon find the experimenters providing the orifice with replaceable bushings. The development of the orifice bushing is shown in Fig. 2. (A) From U. S. patent No. 836,297 to H. M. Brookfield shows an example of the simple orifice. (B) From U. S. patent 770,964 to B. H. Hilde discloses a tapered bushing held in place by gravity. (C) From U. S. patent No. 901,881 to George E. Cleveland, shows a type that must be removed and replaced from below. (D) From U. S. patent No. 1,200,195 to Hubbard and Ruppert shows a straight sleeve supported from below.

Provision must be made for changing the bushing quickly and when it is only a matter of size of outlet in question it has been found desirable to divide the bushing on a horizontal line and only renew the lower section to make a limited change in size of the flowing stream. This lower bushing should be of such shape and so situated as to be easily removed and replaced.

A number of such bushings are shown in Fig. 3:

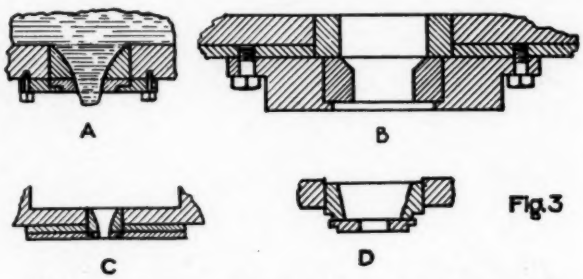

Fig. 3

(A) from U. S. patent No. 1,451,707 to Wm. J. Miller. (Also shown in Nos. 1,462,491, 1,621,426, 1,628,324, 1,642,967.)

(B) from U. S. patent No. 1,507,852 to C. W. Pleukharp, et al.

(C) from U. S. patent No. 1,512,373 to L. D. Soubier. (Also shown in Nos. 1,520,213, 1,512,374 and 1,631,230.)

(D) from U. S. patent No. 1,618,271 to A. N. Cramer.

After securing a flow of glass the next problem is that of separating the stream of glass into gobs or mold charges. Several methods have been devised for doing this including the use of flame, electric spark, electric resistance, impinging hot gases against the stream and shears. Of these shears alone have gained any prominence.

In Fig. 4 a number of these proposed severing means have been redrawn from the patents:

(A) from U. S. patent No. 814,773 to Dixon and Marsh shows apparatus for severing a stream of glass by impinging a stream of gas such as superheated steam against the glass.

(B) from U. S. patent No. 1,002,954 to John I. Arbogast shows burning-off by means of a flame. Also shows cutting by means of electric sparks.

(C) from U. S. patent No. 1,059,634 to L. W. Proeger, cutting by electric spark.

(D) From U. S. patent No. 1,222,243 and No. 1,649,031 to Karl E. Peiler shows severing by electrical resistance.

A number of devices for shearing glass have been proposed but these may be divided into a few groups. Examples of these are shown in Fig. 5:

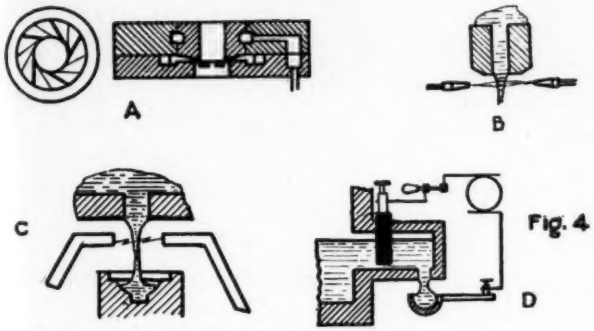

Fig. 4

(A) from U. S. patent No. 810,167 to W. D. Morrison shows a ring type shear in which glass flows through two adjacent rings in vertical axial alignment. A horizontal movement of the lower blade or ring shears the stream of glass.

(B) from U. S. patent No. 1,388,214 to Davidson and Schram shows co-acting straight blade shears that are for all practical purposes mechanically operated hand shears.

(C) from U. S. patent No. 805,067 to H. K. Hitchcock shows co-acting V-shaped shears operating about a common center.

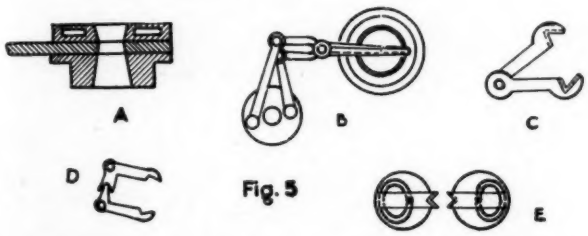

Fig. 5

(D) from U. S. patent No. 1,349,551 to Karl E. Peiler shows V-shaped blades acting on individual centers or bearings.

(E) from U. S. patent No. 605,648 to Frank O'Neill shows co-acting V-shaped shears having a straight line movement.

Shears have been devised that have a stationary blade. Sometimes the lower blade is stationary and sometimes it is the upper blade.

Shears are also shown where the blades are supposed to chop off the glass by having the blades in the same plane and the two edges coming together. If this were a practicable idea it would save a lot of worry about the deforming of the depending bit of glass or the throwing of the gob of glass by the lower blade in shearing.

Thickness of blade comes in for considerable discussion. The ideal blade would have no thickness and approach the stream of glass from all directions, but the blade must be heavy enough to stand the mechanical stress and resist the temperature strain imposed upon it. Triangular or parabola shaped blades will approach the effect of cutting from all directions simultaneously.

The straight line movement of the shears has the advantage of increasing the symmetry of the cutting action but the advantage would not justify seriously complicating the machine to obtain it.

Clearance on cutting tools is so universal especially on

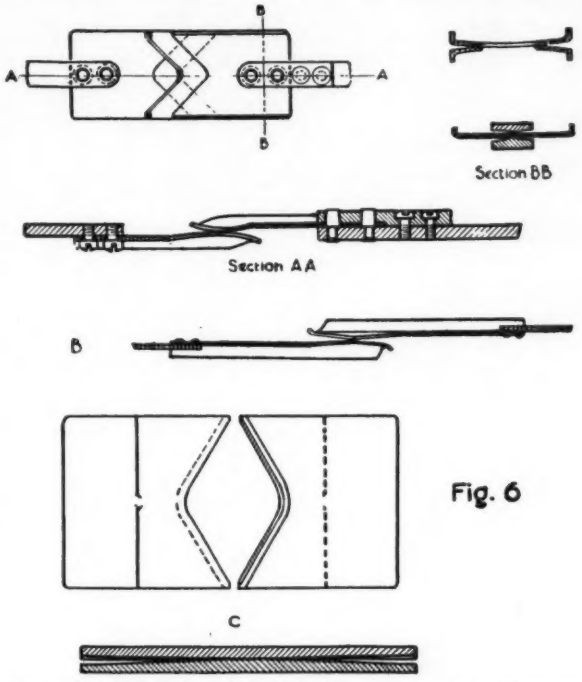

Fig. 6

shears that its use is ordinarily taken for granted. However some inventors have gone into detail to show this feature of their invention. Some of these are shown in Fig 6:

(A) from U. S. patent No. 1,326,640 to W. A. Lorenz discloses shears that not only have clearance but also have a self-aligning feature that is very interesting inasmuch as few shear blades retain their original shape under working conditions.

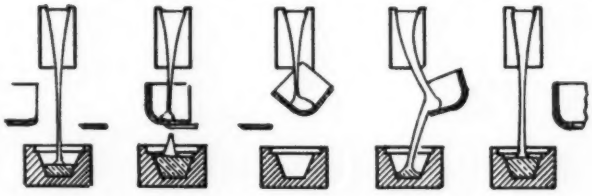

Fig.7

(B) from U. S. patent No. 1,379,594 to Karl E. Peiler.

(C) from U. S. patent No. 1,642,966 to Wm. J. Miller show similar action.

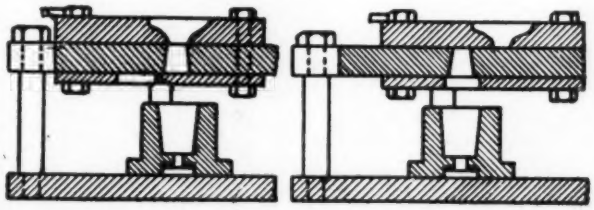

Fig. 8

The operation of the shears has been accomplished by means of cams, air cylinders, and machine drive. Due to the possibility of stones, cold glass, etc., getting between the blades, the closing force should be of a yielding nature to prevent injury to blades or machine.

The cup and shear combination is so crude and unsatisfactory in its performance that it need only be mentioned as a part of the feeder development.

In Fig 7 some of the different types of cups are shown:

(A) U. S. patent No. 723,983 to Homer Brooke is a moving picture showing the principle involved. The cup is used for collecting the molten glass during the mold indexing period.

Other cups have been devised for the purpose of measuring definite quantities of glass, such as the one shown in Fig. 8 from U. S. patent No. 549,404 to T. C. Steimer.

Still other cups have been devised for the purpose of shaping the gob. Fig 9 from U. S. patent No. 1,527,708 to A. L. Schram et al., shows an example of this type.

Many of these cups came into use but the resulting product was so unsightly that their field of usefulness was limited to the very roughest wares.

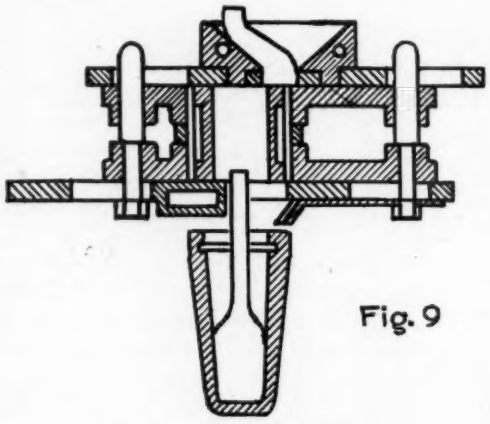

Fig. 9

Several methods have been proposed to retard the flow of glass or create pulsations in the flow. These can be roughly classed under five heads, the pump, sometimes called the hydrostatic, pneumatic, wave or paddle, reciprocating needle, and miscellaneous.

Example of the pump type is given in Fig. 10:

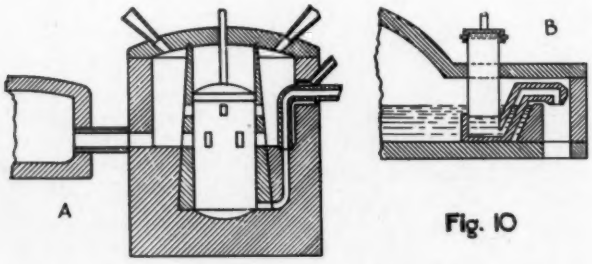

Fig. 10

(A) from U. S. patent No. 691,371 to C. W. Foster.

(B) from U. S. patent No. 892,013 to H. Severin.

Such arrangements were too complicated for the work they were expected to perform.

Fig. 11:

(A) U. S. patent No. 805,067 to H. K. Hitchcock.

(B) U. S. patent No. 1,059,634 to L. W. Proeger.

(C) U. S. patent No. 1,382,994 to C. R. Lott.

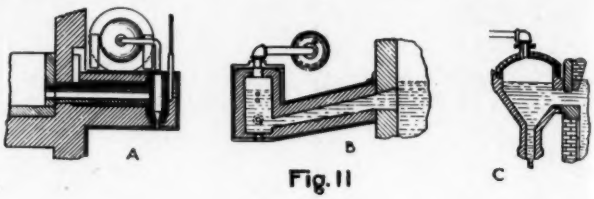

Fig. 11

Fig. 12 shows another type in which the pneumatic pressure is localized in a tube held in the glass over the orifice:

(A) U. S. patent No. 901,881 to George E. Cleveland.

(B) U. S. patents No. 1,281,083, and No. 1,322,318 to R. E. McCauley.

(C) U. S. patent No. 1,315,668 to George E. Howard.

(D) U. S. patent No. 1,405,936 to Karl E. Peiler.

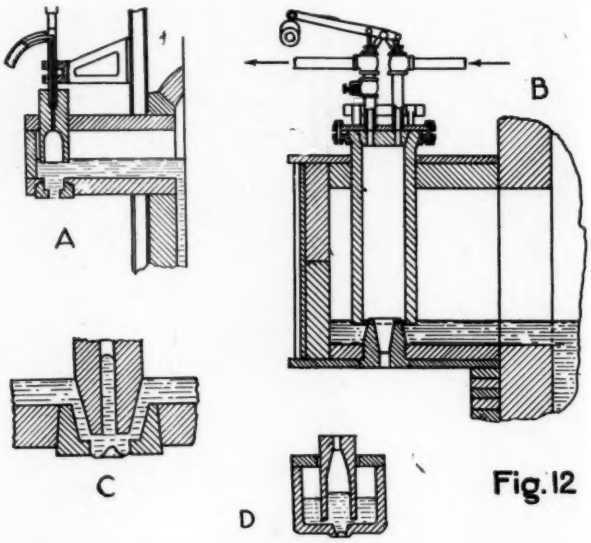

Fig. 12

A paddle feeder is shown in Fig. 13:

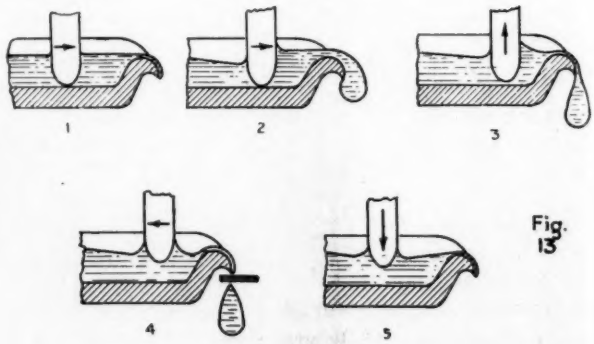

Fig. 13

(A) from U. S. patents No. 1,573,742, and No. 1,277,254 to Karl E. Peiler gives moving picture of the gob development by this type of feeder.

(To Be Continued)

New and Startling Theory of the Mechanism of Lubrication

Of Much Significance to the Glass Industry

AS an outcome of the work of the Lubrication Engineering Committee of the American Society of Mechanical Engineers, a new and startling theory of the Mechanism of Lubrication has been developed and was presented to an Informal Conference at the Engineering Societies Building, New York, on June first, under the auspices of the Society.

The practical importance of this theory lies in the fact that it proposed novel bases for the evaluation of the lubricating properties of oils and greases and, incidentally offers an explanation for a number of matters that have been puzzling lubrication engineers in the past.

The development of this theory has been made possible by discoveries of new features in the behavior of lubricants which in turn have been made possible through tests made on a new machine for investigating phenomena of lubrication erected by the Sperry Gyroscope Company.

The new theory of lubrication offers factual support for the discoveries of German investigators, such as Viewig, to the effect that lubricating properties of oil as such are not determined by the viscosity of the oil.

It also offers experimental proof of the correctness of Langmuir's theory under which a layer of lubricant one molecule thick is held by chemical forces at the face of the metal, as well as the theory of French investigators supported by Sir J. J. Thompson, the famous British physicist, to the effect that a comparatively heavy layer of oil is held to the face of the metal by electrical or magnetic fields.

With the new machine, not only has the actual presence of these layers been confirmed but the lubricant has been found to peel off layer after layer. It has been further discovered that we finally reach an "ultimate" layer which does not peel off, even when enormous disruptive forces have been applied to it.

Another startling discovery has been that if the ultimate layer is wiped off the face of the metal a new layer of lubricant is immediately created thereon and, for example, in the case of a steel lubricated surface, as many as 21 layers of oil have been wiped off where the presence of even a single fluid layer has never been suspected before.

With these and certain other facts as a foundation, a new picture of the mechanism of lubrication has been built up. Briefly, according to this theory a layer of oil is formed on the surface of the metal, the thickness and strength characteristics of this layer being determined by the character of the lubricant, and the character of the metal. This layer, in turn, pumps up under an enormous pressure of oil into the crevices of the metal. (This is in accord with the most modern conceptions of phenomena of adsorption). In the course of contact with the bearing surfaces on the journal and the brasses (the same especially applies to ball and roller bearings as well as Kingsbury bearings), the free film plays no part as a means of separating the surfaces of the metal. This is done by the newly discovered powerful adhering layers of lubricant and when, in the course of operation of the bearing, these are wiped off, they are immediately restored by the oil ejected under enormous pressure from the crevices in and under the metal surfaces. The remarkable circumstance is therefore established that any lubrication is essentially high pressure lubrication.

In the above mechanism of lubrication entirely new functions are ascribed to the free film of lubricant. Incidentally, tests on the new machine have given a basis for serious intimation that lubricants (many if not all) consist of two parts: one performing the functions of the lubricant and the other acting as a colloidal solvent thereto. The present apparatus for measuring viscosity gives figures which apply to the two constituents of the lubricants jointly and none of the existing methods measures the viscosity of the constituents singly. If viscosity has any bearing on the lubricating properties of the oil, it is only the viscosity of the lubricating constituents of the lubricant and not the diluent constituent. Because of this, all present attempts to tie up the viscosity of lubricants with their lubricity are placed under suspicion and will remain so until the "true" viscosity of the lubricants is determined.

A closer knowledge of the mechanism of lubrication is imperatively necessary today. First, because with the speeds and loads used in our present machinery, the difficulty of the problem of lubrication has increased tremendously as compared with even the recent past. We have reached the stage where in order to handle the lubricating problems we have to have a precise knowledge of the behavior of metals towards lubricants and lubricants towards metals.

We can no more be satisfied with guesses and assumptions. In the next place, so many lubricants are offered to engineers nowadays and so great is the responsibility of the engineer who is to make selection from among this mass that rapid and reliable methods of testing become exceptionally important and, of course, no testing can be accomplished in a satisfactory manner unless we can place a definite and proper value on the various factors, and that means, unless we have in our minds a clear picture of the mechanism of lubrication. The paper has been prepared for the Lubrication Engineering Committee by William F. Parish, Chairman of the Committee, formerly Chief of the Lubrication Department of the Air Service, War Department, and Leon Cammen, Consulting Engineer.

Tariff Hearing on Laminated Products Postponed

The hearing in connection with investigation No. 30 by the U. S. Tariff Commission scheduled to be held on May 27, 1932, has been postponed until June 7, 1932.

The Manufacture of Rolled Plate

By ERNST LUTZ*

This work has been revised, so far as the English and the technical expressions are concerned, by F. W. Preston, who has also added a number of notes relating in general to the special conditions of American practice; but it must be understood that the opinions expressed in the text are those of Mr. Lutz, and neither the Editor nor Dr. Preston accepts responsibility for them.

(*Continued from the May, 1932, issue*)

The daily production during these tests of rolling plate glass into long sheets was two rough glass sheets of 13⅛′ x 13⅛′ and of an average thickness of 0.300″. The losses in breakage in the annealing kilns were small. The first sheets produced were rather wavy; the roll, however, was only slightly ribbed. After the ribbings had been made of the same magnitude as for rolls for thick plate glass, the waves became less pronounced; however, they were still of such size, that the flatness of the sheets was insufficient. The depth of the ripples could not be further increased as they already left such deep impressions in the glass skin that the cutting of the cooled sheets presented difficulties.

In order to reduce the formation of waves still further the surface of the tables themselves was provided with ripples; one table cross-ways and the other longitudinally. The longitudinal ripples caused no appreciable difficulties as regards the removal of the sheets from the table into the annealing kiln, but the cross-way ripples increased the liability of contaminating the glass mass on the table; this measure reduced the waves to such an extent that their existence was no longer of consequence though they could not be got rid of completely. Apart from these slight waves, the flatness of the individual sheets was such that their grinding and smoothing on tables of about 29½′ diameter took only 65-75% of the time required for the grinding of thick rough glass; the loss in breakage during grinding was about the same; rough glass sheets up to 45 sq. ft. size were set. In order to take off the rough glass skin everywhere, about 0.063 to 0.087″ per surface, or approximately 0.150″ on both surfaces had to be ground off, so that an average thickness of the polished glass of 0.150″ was arrived at. Measurements which covered a surface of 16,500 sq. ft. showed a variation of thickness between 0.122″ and 0.173″.

The glass contained somewhat numerous impurities originating from the rolling; but this drawback, was not great enough to put the value of the method entirely in doubt. However, the cooling cracks described above in the method with small pots, were here present to such an extent that the commercial adoption of the method could not be risked. For instance, with sheets rolled down to a thickness of 0.275″, the fire cracks or checks were so numerous and so deep that by far the greater part of the glass had to be considered as waste. Just as with the method using small pots, this drawback could be reduced if the sheet thickness could be kept over $\frac{5}{16}$″. This, in the ordinary course, would yield polished sheets almost invariably of over 0.157″; smaller thicknesses would require a prolonged grinding.

Bicheroux System, Newer Form

The experiences gained from these tests led Bicheroux to the method known under his name. The drawbacks and peculiarities of the above method are dealt with in the U. S. A. patent specification 1,673,347 and in the German No. 334,699 of November 16th, 1918, which also describes the method underlying the Bicheroux casting table method. As in the arrangements of some best semi-white glass manufacturers which we have mentioned before, this invention again goes back to the method of the Chance-rolling-mill, i.e., to the production of rough-, wire-, figured-glass, and the like, which is not intended for grinding and polishing, and where the glass thickness is fixed by two rolls cooperating with each other. In this way as stated before, the glass comes less intimately in contact with the metal and the possibility exists of guiding the rolled glass ribbon on to a support of low thermal conductivity. This support is not exposed to pressure, and the skin of the glass ribbon, when coming in contact with it, has already congealed to such a degree that it no longer sticks. In practice, however, one has come back to the use of cast iron tables for the construction of the plants. In order to avoid too rapid leading off of the heat and the consequent cracks on the glass surface, the surfaces of table and glass are channelled in directions at right angles to each other. The effect of this is that the warm glass and the cold iron touch each other at points only leaving between glass and iron a layer of air that acts as a thermal insulator. In plants of the newest type (General Motors) the glass ribbon does not run on conveying tables but on conveying rollers which carry the glass to and through the annealing lehr. (Fig. 236 A). This system likewise limits the contact of glass and metal to an innocuous period of time. In contrast with the manufacture of wire, figured and the like glass-sheets, where only small quantities of glass are admitted to the rolls and where the purity of the glass plays a secondary part, the said invention also enables the admission of the content of a large pot so that, as in the casting of thick rough plate glass, the glass is poured in one bulk and in one operation, thus maintaining the purity of the glass mass.

The characteristics of this method and the machinery required for its application may first be described with the aid of the above-mentioned patent specification; see also

* Of Dessau, Germany. This work is appearing in German in the new edition of *Dralle-Keppeler*, "Die Glasfabrikation."

FOOTNOTE: In the Figures, originally prepared for use eventually in the new edition in the German language of *Dralle-Keppeler*, "Die Glasfabrikation" in 1931, dimensions are given in metres (*m*) and millimetres (*mm*). We would like to have given these in feet and inches but the translation and the making of nearly two hundred and fifty new illustrations would have involved a prohibitive loss of time and expense. To some of our readers the metric system is as familiar as the English units; for the others we may say that a metre is approximately 40 inches, and a millimetre is approximately 1/25 of an inch. A thousand millimetres, of course, go to a metre.—F. W. P.

Figs. 224 and 225. As will be seen later on, the practical introduction required a number of alterations and important additions. For tilting a large pot without impairing the

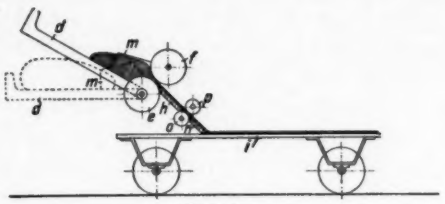

FIG. 224

purity of the glass mass and to ensure its correct spreading without getting an excessive long glass ribbon, depending on the size of the pot, a space of at least 11½ to 16½′, measured in the direction of the longitudinal axis of the roll, is

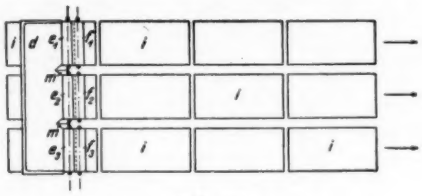

FIG. 225

necessary. Unsupported rolls of such a length need very heavy bearings and drives, tending to shocks; long rolls are also more sensitive to the influence of heat than short ones. On the other hand, a single short pair of rolls would produce a glass ribbon of such length that, in spite of the glass core keeping its heat, the end of the sheet would get too stiff. For this reason the full mill-length was covered by a number of short rolling machines, as shown for instance in Fig. 225 in three parts (e_1 f_1, e_2 f_2 and e_3 f_3). In between each two machines a certain space is required for the bearings and the drives; in order to admit the glass to each of the machines in such a way that the intermediate space is kept free, special shoulders or cutwaters m were provided on the base d.

To allow the pot content to be poured in the established way on to the horizontal plane, the base d (Fig. 224) called the "receiver" in the specification, can turn round the axis of the roll e; after or during the pouring this "receiver" is swung upwards until the cutwaters m seal against the rolls f and the glass flows to the rollers by gravity. The specification further describes a special design in which the receiver d is rigidly connected with the side protection of the roll, so that receiver and rolls f swing jointly round the axis of the roll e. In this case the shoulders m keep their sealing position towards all rolls permanently.

Below the rolls e,f, if required, a second roller pair can be provided for equalizing possible inequalities of the sheet thickness.

At the bottom of the slope h the three glass ribbons are taken up by succeeding trucks i, the movement of which is positively connected with the movement of the roll; these trucks, however, should preferably move a trifle faster, so as to avoid the liability of the ribbons forming humps.

If the glass ribbons rolled simultaneously from one pot have a combined width of 13 to 16′, i.e., similar to the thick rough glass sheets, and if they are half as thick as these latter, ribbons of approx. 66′ length are produced; if the combined width is less, the length of the sheets is accordingly greater. These unhandy long ribbons must be cut near the rolls and subdivided into shorter sheets. For this reason the necessity arose of combining cutting devices with the mill. Such an arrangement had already been suggested and described for instance, in the German patent letter 159,628 of April 15th, 1905, by N. Harrison, J. Wharton and S. R. Wightman. It is expedient to cut the sheets at the points where the trucks i meet and to bring them right on these trucks to the annealing kilns.

Practical experience has shown that this procedure lends itself to mass production and it avoids the drawbacks of the usual methods for the production of thin plate glass either by blowing or stretching on a roller table; at the same time it is claimed that it combines the advantages of both methods, such as: pure glass, absence of cooling cracks, flatness, flexibility with regard to the pot size, no limits regarding the glass thickness, smallest and lowest possible cost of production.*

The practical way of giving effect to the principle is illustrated by Figs. 226-236 which were kindly put at our disposal by the "Deutsche Glastechnische Gesellschaft." (See

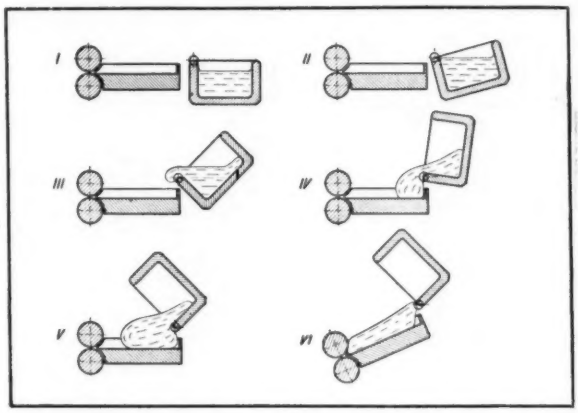

FIG. 226

also the U. S. A. patent specifications 1,621,054, 1,621,144, 1,673,098 and 1,673,138.)

Fig. 226 shows diagrammatically the six main positions of the melting pots, the receivers and the two rolls during the pouring of the glass. It must be particularly pointed out that, in contrast to usual practice, the pot is not turned round its center of gravity but round the lip of the pot nearest the mill. The glass thus falls through a considerable less height than in the ordinary way; see Figs. 72 and 73; its liability of sputtering, i.e., of forming creases and of imprisoning air bubbles is thereby appreciably reduced. According to U. S. patent 1,673,138 of Max Bicheroux, Aachen, Germany, this tilting motion of the pot is attained by constructing the cast-

*In connection with this method reference is made to two very interesting reports by Dr. A. Wendler and by L. V. Reis in "Glastechnische Berichte" No. 8, November, 1927, and No. 12, March, 1930. This literature is especially referred to because of the importance of this system and because of the reasons mentioned above.

ing tongs in an eccentric form and bending their axis of revolution in such a way that it is placed on the same level and in the same direction as the pouring lip of the pot (Figs. 226-A and 226-B). . . ." The rolling is started while the pouring is still going on, and the glass thus stays for only a short time on the receiver. This latter is kept as small as possible, so as further to reduce the cooling of the glass mass.

As shown in Fig. 227, the receiver is initially somewhat inclined so that the forefront of the glass heap slides at once towards the rolls, ensuring space for the succeeding mass.

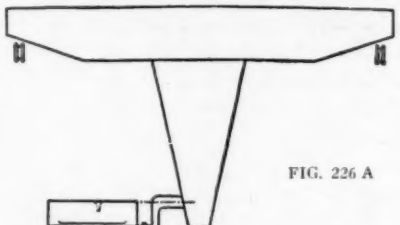

FIG. 226 A

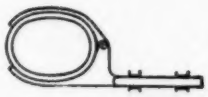

FIG. 226 B

If now, as shown in position IV the receiver, and with it the upper roll, are swung around the axis of the lower roll, the glass mass will gather in front of the upper roll and thus be all the better admitted to the mill.

Figs. 231 and 232 also show the truck drive. From the

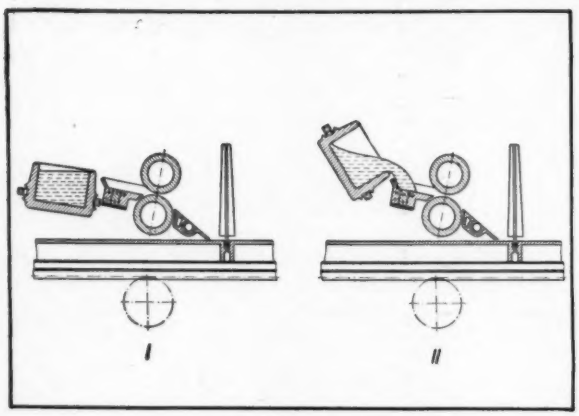

FIG. 227

roll the glass ribbon slides shown an inclined plane on to the trucks. The velocity of rolling is 1 to 1⅔ ft. per second. The trucks travel with the same velocity whilst the glass is put on; however, the velocity of the trucks may rather be a little faster than slower in order to avoid any damming up or lapping of the glass. After the glass of a fully covered table has been separated from the following glass ribbon, the velocity of the truck is accelerated to about 10 ft. per second and the truck is driven at increased speed to the lehrs. To the inclined plane a brake-roll is fitted which prevents tearing or sidewise escape of the glass ribbon.

The truck consists of three parts which form these tables separated from each other in the direction of the roller axis, i.e., crosswise to their path. The clearances separating the tables serve as cutting lines, into which the knives penetrate and cut the glass along the table edges. The positions I, II and III show the knives in their upper position and IV in their lower one. Figs. 233, 234 and 235 show the way of arranging these knives; during cutting, they must follow the movement of the truck, and after cutting must be removed back to the roll into their initial position. As stated before, the table surfaces consist of ribbed cast iron plates, the rolls are similarly ribbed. It has also been stated before that in one of the new American plants devised for very large production the glass sheet is not led on trucks but on conveying

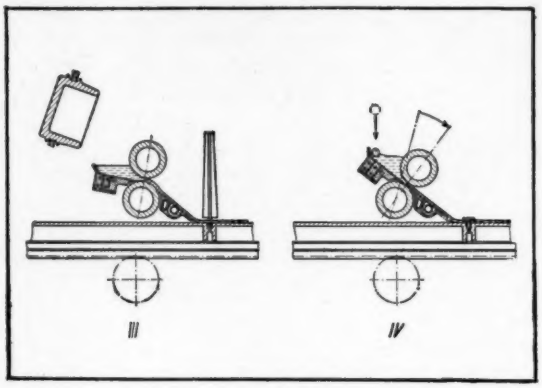

FIG. 228

rollers which carry it to and through the lehr. This combination of the Bicheroux rolling machine and a lehr with conveying rollers has the great advantage that the entire

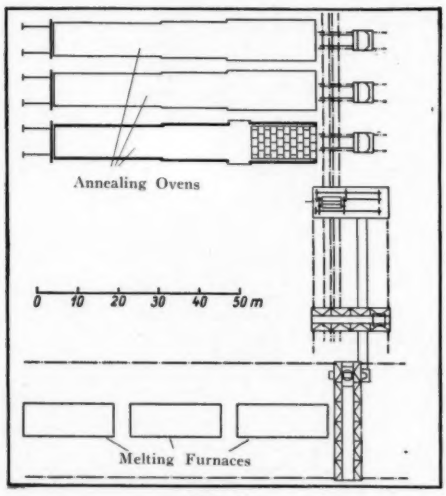

FIG. 229

glass sheet coming out of one melting pot can be sent into and through the lehr without being divided. This system makes unnecessary the devices for the immediate cutting of the hot glass sheet as it comes from the rolling machine. Furthermore the trucks which have to be driven to and fro between the machine and the lehrs can be omitted as well as the voluminous and complicated devices for shifting.

The thinner the glass is rolled, the greater is the danger in annealing; again these difficulties will be the greater the

larger the individual sheets are made. For this reason, when rolling particularly thin sheets, the glass ribbon is also subdivided lengthways, so that with three tables six small sheets are produced. Figs. 234-235 show the required cutting equipment. However, one soon learned to treat larger sheets so that they came unhurt through the lehrs. The equipment for cutting lengthways was therefore omitted as may be seen from Fig. 235-A.

FIG. 230

Fig. 229 illustrates the lay-out of a glass factory working with the Bicheroux method and includes also the melting furnaces and annealing kilns. Over and across the melting furnaces a ceiling crane moves with a pot-tongs suspended on to it. With this the melting pots are brought within reach of the teeming crane, noticeable in Fig. 230. This ground plan shows further how the truck runs from the

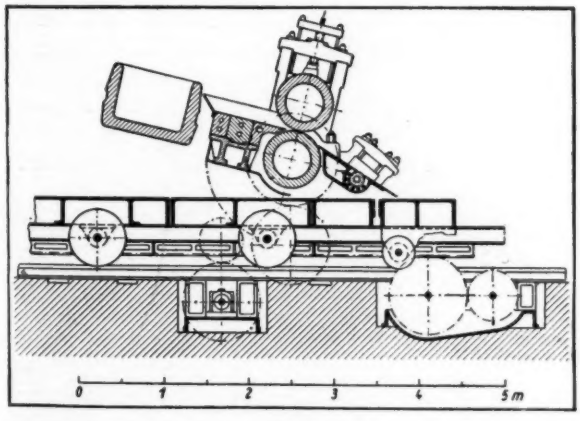

FIG. 231

mill immediately in front of the three annealing kilns, so that newly-rolled sheets are conveyed thereto without loss of time. The arrangement for the shifting of the sheets is illustrated in Fig. 236. This method is now used with great success in both the United States and Europe.

The following information is obtained from a special report by Herr von Reis, Herzogenrath: "In the course of its last stages of development the principles of the Bicheroux-machine have remained unaltered but the performance has been improved."

In its first form it produced but small sheets up to about 6½ ft in width. Since then thin sheets down to 5/32" have been successfully produced undivided, i.e., up to 13 ft. wide. This was made possible by accelerating the rolling velocity up to 2 ft. per second and by accelerating the travelling speed of the rolled glasses to even more than 6½ ft. per second. Besides, the various parts of the shifting device (Fig. 236) were made so sensitive that there is no fear of the thin sheets getting damaged. In this development

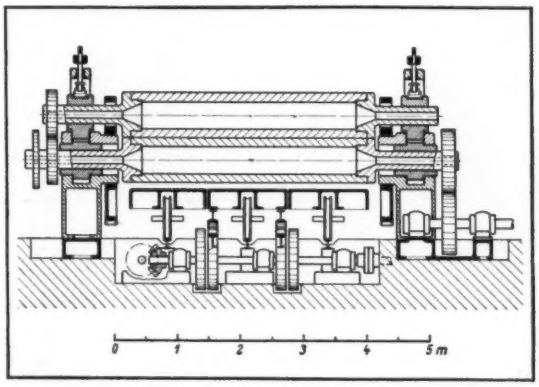

FIG. 232

the greatest interest resides in the stowing tools which rest in elastic bearings and are moveable in all directions. This mobility allows the shovels to fit the edges of the sheets in all positions.

Furthermore, the cooling of those parts that are exposed to the heat, i.e., the receiver, the rolls and the oblique sliding plane can now be taken care of and the expansion by heat can now be handled in such a way that a continuous operation of 24 hours (as called for in the States, though not in Europe) can be carried through.

The parts most afflicted by the heat are undoubtedly the cast iron conveying tables. Although the transfer of heat from the hot glass plates to the table is considerably lessened by the cross rippling of roll and table, it is still so high that the table surface reaches a temperature of approximately 570° Fahrenheit. A solid table would not be able to stand the tension which is the reason for dividing the table into a great number of small segments. Between the single segments are expansion joints. All the difficulties in the construction of the tables are avoided if the glass is not transported on conveying tables but on rollers which at the same time perform the functions of cooling and straightening of the glass plates.

Fig. 236-A shows the Bicheroux-machine combined with a lehr with rollers (hot end); Fig. 236-B shows the plates leaving the cool end of the lehr. This combination is employed by the National Plate Glass Co. of Ottawa intended to furnish all the plate glass General Motors need for their automobile production.* The pots used there contain 28¼ cu. ft. The pouring by means of a special pouring crane and the rolling in the Bicheroux-machine are done in the normal way. The plates are rolled to a width of about 12 ft. Depending on the thickness of the rough glass, lying somewhere between 11/32″ and 5/32″, the glass ribbon has a length of about 46 ft. or 100 ft. respectively.

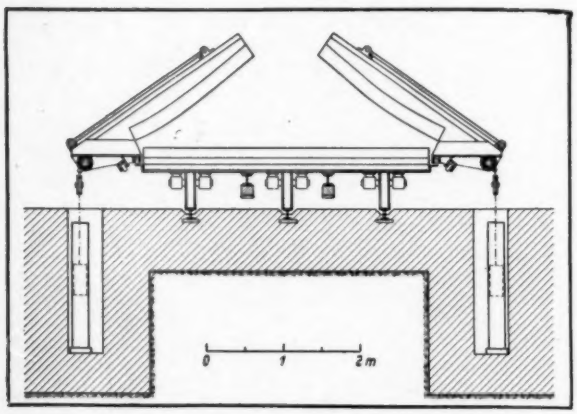

FIG. 233

At first the glass ribbon is carried forward on an uncovered way of rollers until it has cooled down to about the critical temperature. Then, the cooling speed is slowed down in the lehr in order to escape cooling strains. Accordingly, the initial temperature of the lehr is about 1100° Fahrenheit. The cooling time in the lehr which is approximately 740 ft. long, is around 1 hour for glass of 11/32″ thickness. The lehr is heated electrically and requires about 700 kilowatts which is a rather large consumption of power. The cooling is performed in such a way that the sheets do not travel at an equally slow pace through the lehr but travel forward and backward in much the same way pilgrims do.† This is of especial favorable influence on good cooling.

This rough glass plant is capable of a daily output of 130,000 to 260,000 sq. ft. of rough glass so that it amounts to an output of about 40-80 millions sq. ft. per year. The demand in 1930 amounted to about 75 per cent of the capacity.

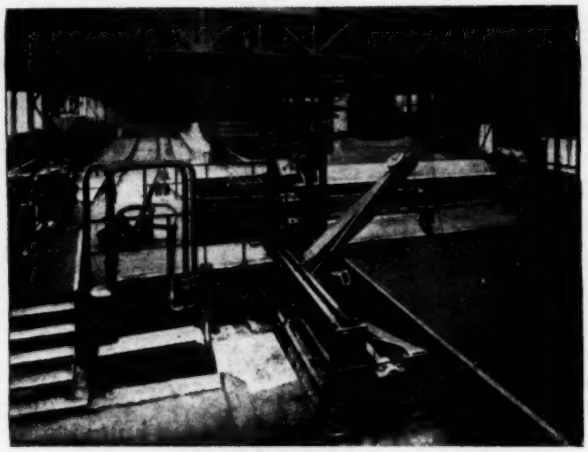

FIG. 234

Lehrs with rollers are, by reason of their high costs of construction as well as of operation, adapted to production on a very large scale only; therefore in most cases they cannot be considered for European factories. Their place is taken by the improved lehr with pre-annealing chambers or "ovens" but arranged in a single straight line. The previous zigzag form of the annealing chambers that lay before the annealing channel was built because one could not construct shifting devices that could stand up to the high temperatures of the pre-annealing chambers for a long period of time. The zigzag arrangement permitted the handling of the shifting shovels with pipes that did not need to be longer than one plate and that were cooled after each performance by the outside air. This arrangement was safe, but required a lot of attendants besides causing unfavorable cooling conditions since the zigzag arrangement of the chambers resulted in many "dead" corners which were not entirely reached by the heating stream of gas.

The Herzogenrath Glass Works succeeded in constructing shifting tools which could continuously stand a temperature of 1300° Fahrenheit. The result of this constructive improvement is a simple and straight lehr which can be attended to automatically in a simple fashion and which, at the same time, realizes the best conditions for good annealing. The shifting tools are iron shovels which are carried by strong steel pipes. These steel pipes are cooled by air inside and are well insulated outside. Thus, on the one hand, loss of heat and unfavorable effects upon the glass to be annealed can be avoided, while, on the other hand, the walls of the pipes do not exceed the admissible temperature of about 570° Fahrenheit. The whole system: the pipes and the lateral pipe carriers running on rollers are combined to a complete, coherent pipe system. Figs. 236

(*Continued on following page*)

*This arrangement has probably come to a bad end with the taking over of the National Plate by Libbey-Owens-Ford. We presume the thin glass needed by General Motors will now come mainly from the other plants of L.-O.-F.—F. W. P.

†Pilgrims in America keep right on at forty-five miles or lower or faster. The sheets in the Ottawa lehr are like the monkey on the greasy pole. who climbs three feet and slips back two at every effort.—F. W. P.

Charles Merz Reviews American Industry

An inventory of the slump from the peak of production to the present is given by Charles Merz in the *New York Times* of Sunday, May 29. Under the heads of farming, railways, banking, steel, building, automobiles, and foreign trade, Mr. Merz discusses his subjects, makes comparison of the 1931 statistics with previous years and bases conclusions on the facts brought out.

Regarding farming, he states that the chief difficulties confronting American agriculture in 1932 may be identified as follows:

1. During the last six months a fresh decline has carried the average price of all farm products, measured by the index number of the Bureau of Labor Statistics, well below its immediate pre-war level.

2. Increased acreage last year, with bumper crops of both wheat and cotton, resulted in large carryovers of these two mainstays, to the disadvantage of this year's production.

3. New tariffs abroad have curtailed the markets for American foodstuffs. In a recent bulletin the Department of Agriculture, which favors tariffs at home, described the extent to which "foreign business in farm products is now hampered by trade restrictions."

Mitigating factors are:

1. While about 20 per cent of the farms in the United States are mortgaged for more than half their value, over 50 per cent are wholly free of mortgage charges.

2. A reduction of 10 per cent in Winter wheat acreage this year has been predicted by the Department of Agriculture, with a forecast of the smallest crop with one exception since the war.

3. Present indications point to the smallest cotton crop abroad since 1926-27—1,400,000 bales below last year—and to a sharply reduced crop of wheat in Russia and the Danube Basin.

4. The Federal Farm Board, which purchased 329,000,000 bushels of wheat and 1,300,000 bales of cotton in an effort to stabilize the prices of these products, only to describe its holdings, later on, as "a black cloud hanging over the market," has now disposed of all but 95,000,000 bushels of its wheat, according to recent press dispatches, and plans to sell half of its cotton during the coming season.

Regarding railways, he points out that:

It is evident that long before the depression overtook business the railways were losing passenger traffic to motor buses and to private automobiles. Freight traffic, however, remained at a high level until the end of 1929. It fell 24% below the figure for that year in 1931, but remained above the level reached during the last general depression of business in 1921. During 1932, however, there has been a further loss of traffic.

The loss of traffic has been followed by a reduction in railway employment. A second consequence has been the smaller earnings for the railroads. Some of them are still paying dividends but a large number are not earning fixed charges.

> The two great difficulties of the present situation are readily apparent: First, loss of revenue-producing traffic, and, second, the mass of funded debt which rests on many properties, representing in some cases, in the opinion of the Interstate Commerce Commission, a top-heavy capitalization.

Banking tables are given by Mr. Merz showing that bank failures increased from 642 in 1929 with deposits of $234,532,000 to 2,298 in 1931 with $1,691,510,000.

> Compared with the experience of Canada, which has had only twenty-six bank failures since its confederation in 1867, this record offers convincing evidence of the inadequacy of existing methods of regulation and control. It shows, however, that our recent experience has merely been an intensified version of our experience before 1929, since bank failures are not a phenomenon only of hard times but occur in discouragingly large numbers during years of plenty.
>
> Perhaps the best that can be said of these figures is that the savings banks have stood intact, gaining more than a billion dollars in deposits during 1930 and 1931; that few large commercial banks have closed their doors; and that, in the words of the Controller of the Currency, failures are "still predominantly a small-bank problem."
>
> The sharp decrease in the number of failures during the last two months is evident, and offers striking proof of the improvement brought about by the adoption of the Glass-Steagall act and the operations of the Reconstruction Finance Corporation.

Mr. Merz's comments on the steel industry quote Charles M. Schwab as stating that the five leading companies in the industry for the first quarter of this year failed to earn their interest, depreciation, and other charges by 25 million dollars. Production in 1931 fell 56% below that for 1929, although it remained well above the figure for the 1921 depression. Encouraging features, however, have been noted by some observers such as anticipated increased purchases of railroads whose needs have been accumulating over a long period.

The current situation may be judged from the fact that all of the railways in the United States purchased only 41 locomotives in the last six months of 1931 and only 11 passenger cars in the entire year. Due, it is believed, to the expansion of automobile orders the weekly steel production index advanced from 23.2 in mid-April to 26.3 in the latter half of May. The steel industry, however, is operating at about one-quarter capacity.

From the peak production of automobile passenger cars of 4,795,000 in 1929 production in 1931 was reduced to 1,973,000. During the same period the value of trucks built in 1929 amounted to $827,000,000 while that of the 1931 production was $417,000,000. During the first three months of 1932 output fell about 50% below the same period of 1931, but "a delayed seasonal expansion, comparable with that in the steel industry and encouraging for the same reason, appeared in the latter half of April at a time when a decline in operations was ordinarily to be expected." This expansion is still continuing.

Prices of all materials used in making automobiles have been radically reduced since 1929. The statistical position of the industry is favorable. On reliable estimates the average life of a motor car is seven years. Figured on this basis, the replacement demand should have been for about 3,300,000 cars in 1931 and about 3,900,999 in 1932, a total of 7,200,000. Since domestic production in 1931 amounted to less than 2,000,000 there is theoretically at least an accumulated demand for about 5,000,000 cars.

> So far as the immediate future of the building trades is concerned, the factor most likely to affect the situation in the building trades is the outcome of the present debate in Washington over a program of public works. The plans submitted both by the President and by the Democratic subcommittee contemplate an addition of $1,500,000,000 to the resources of the Reconstruction Finance Corporation, a large part of which would be used for new construction.

As a measure of the effects on American conditions of foreign trade, the exports in 1929 amounted to $5,240,000, in 1931 to $2,224,000; imports dropped from $4,399,000 in 1929 to $2,090,000. This indicates that our difficulties are not wholly local.

> As the force of the depression spends itself, purchasing power may be expected gradually to revive. But tariffs, quota systems and trade controls will remain until they are repealed; and they will presumably not be repealed until the influences which they are designed to correct have disappeared. At this point the problem of a recovery of our foreign trade is merged with the larger problems of debts, credits and world confidence.
>
> No American industry operates in isolation. The fortune of the American farmer, the stability of American banks, the welfare of our transportation companies and the activity of our steel mills, automobile factories and, less directly, building trades have all been touched at many points since 1929 by forces which recognize no national frontiers.

Plate Glass

(*Continued from page* 108)

C, D and D′ show sections and the view of the head of such a lehr. Most of the constructions of the Bicheroux-system are equipped with two lehrs of this kind. A standard plant is shown by Fig. 236-E. Plants of this type are operating in Germany, Belgium, France, Spain, Czechoslovakia, England and America.

Glass Industry

ESTABLISHED 1920

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Reference to the contents of earlier issues of THE GLASS INDUSTRY can be found in THE INDUSTRIAL ARTS INDEX in many Public and Technical Libraries.

Use of Ammonium Sulphate

Mr. F. W. Preston,
c/o Glass Industry Publishing Company,
New York, N. Y.

Dear Sir:

We are very much interested in your note on the "Use of Ammonium Sulphate" on page 90 of the May issue of THE GLASS INDUSTRY.

We have been using a small amount of ammonium sulphate in our dark glasses in which the color is obtained from manganese and bi-chromate. The results have been very satisfactory, the color is more stable and less trouble results from reducing atmosphere than when the ammonium sulphate is omitted from the batch.

Due to the greater apparent mobility of the glass, the refractories are honeycombed at the metal line more than without the use of the material.

Yours very truly,
H. K. RICHARDSON,
Engineering Department,
WESTINGHOUSE LAMP CO.

Bloomfield, N. J.
May 17, 1932.

May 19th, 1932.

Dear Sir:

It is to be presumed that the effect of ammonium sulphate is essentially an oxidizing one, and that in the case of your dark glasses, the addition of this chemical will be to maintain the dark purple color of the manganese dioxide in spite of any reducing action of the flames. This will more than compensate for the possible bleaching of the chrome from the deep yellow green to the light green tint. We hope to have fuller data before long.

The last paragraph is interesting, but potassium bichromate is a bad actor where refractories are concerned, whether ammonium sulphate be present or not.

Yours very truly,
F. W. PRESTON.

To Mr. H. K. Richardson,
Engineering Dept., Westinghouse Lamp Co.,
Bloomfield, N. J.

Moonbeam Made to Carry Human Speech

Glass, the indispensable, comes again into prominence by reason of a mirror used as the medium by which a moonbeam was made to carry human speech for the first time. The demonstration took place in the office of Henry L. Doherty, Wall Tower, Pine Street, New York, who was the founder and is the president of the Cities Service Company. The moonbeam condenser was developed by L. W. Chubb, director of research for the Westinghouse Electric and Manufacturing Company, and was operated by Dr. Phillip Thomas, research engineer, and K. A. Ohlinger, optical expert, both of the Westinghouse Company.

As described in the *New York Times* a man with a mirror focused on the moon stood on the balcony of the 64th floor of the building. A 14-inch diameter lens was focused through a 21-inch cone to a tilted vibrating galvanometer mirror, ⅛th of an inch in diameter, which in turn projected the moonbeam on to the cathode of a photo-electric cell. The moonbeam was about one-fourth of an inch in diameter and was charged with electrical energy of one-five thousandth of a watt. A microphone and a broadcasting amplifier were attached to the vibrating mirror.

Mr. Doherty's voice vibrated the moonbeam focused on the mirror, causing the moonbeam to dance on a cathode of an "electric eye" and passing the voice sounds as in talking pictures to the amplifier connected to the outfit attached to the photo-tube and from there to radio listeners everywhere.

It is interesting to reflect that without glass such remarkable scientific achievements would be impossible.

Notes on the Structure of Refractories by S. M. Phelps, Senior Industrial Fellow, Mellon Institute, Pittsburgh, Pa. A six-page technical bulletin No. 34 issued April, 1932, discusses the possible value of proportioning the grain sizes in refractory mixes. Contains the experimental procedure and findings in detail; of non-technical nature and contains useful information for those making a study of the subject.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C., Price 10c each

METHOD OF AND APPARATUS FOR MAKING GLASS ARTICLES. U. S. 1,859,011. May 17, 1932. Charles Wales, La Grange, Ill., assignor to Western Electric Company, Inc., N. Y. Filed 2/6/29.

GLASSWARE FORMING MACHINE. U. S. 1,859,053. May 17, 1932. Harold A. Rohrich, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Filed 7/10/29.

GLASSWARE FORMING APPARATUS. U. S. 1,859,074. May 17, 1932. Albert N. Cramer, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Filed 11/30/28.

GLASS BLOWING MACHINE. U. S. 1,859,113. May 17, 1932. Leonard D. Soubier, Woonsocket, R. I., assignor to Owens-Illinois Glass Company, Toledo, O. Filed 5/27/22.

MEANS FOR MAKING BLOWN GLASS ARTICLES. U. S. 1,859,114. May 17, 1932. Leonard D. Soubier, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Original application filed 9/20/24. Divided and this application filed 10/27/28.

MANUFACTURING OF HOLLOW GLASSWARE. U. S. 1,859,230. May 17, 1932. Robert W. Canfield, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 3/1/29.

GLASSWARE MAKING APPARATUS. U. S. 1,859,231. May 17, 1932. Robert W. Canfield, West Hartford, Conn., assignor to Hartford-Empire Co., Hartford, Conn. Filed 3/30/29.

GLASS FORMING APPARATUS. U. S. 1,859,232. May 17, 1932. Robert W. Canfield, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 4/4/29.

CONTINUOUSLY OPERATING GLASSWARE FORMING MACHINE. U. S. 1,859,233. May 17, 1932. Robert W. Canfield, West Hartford, Conn., assignor to Hartford-Empire Co., Hartford, Conn. Filed 6/15/29.

CONTINUOUS TWO-TABLE GLASSWARE FORMING MACHINE. U. S. 1,859,234. May 17, 1932. Robert W. Canfield, West Hartford, Conn., assignor to Hartford-Empire Co. Filed 1/9/30.

METHOD OF AND APPARATUS FOR FORMING GLASSWARE. U. S. 1,859,235. May 17, 1932. Robert W. Canfield, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 1/29/31.

PROCESS AND APPARATUS FOR PRODUCING SHEET GLASS. U. S. 1,857,809. May 10, 1932. John L. Drake, Toledo, and Luke C. Mambourg, Lancaster, O., assignors to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 8/20/27.

Nivison-Weiskopf Case Decided

The Hartford-Empire Company suit against the Nivison-Weiskopf Company begun in the District Court of the United States, claiming infringement of the Steimer patent 1,564,909, the Peiler "phase change" patent 1,573,742 and Peiler 1,589,304 resulted in an unfavorable decision and was appealed by the plaintiff to the United States Court of Appeals, Sixth Circuit.

On May 12, 1932, a decision by Circuit Judges Moorman, Hicks and Simons was handed down, which affirmed the decree in the Nivison-Weiskopf case as to the Steimer patent and the "shear-height" patent, and in so far as it holds Claims 2, 5, 8 and 9 of the Peiler "phase change" patent valid and infringed and Claims 18 and 28 valid, but is otherwise reversed except that the court does not determine whether the valid apparatus claims are infringed; that the decree in the Kearns-Gorsuch case is affirmed as to the Steimer patent, the Peiler "shear-height" patent, the Peiler "whittling" patent, and as to the Peiler "phase-change" patent in so far as it holds method claims 1, 3, 4, 6, 7 and 10 invalid and apparatus claims 18 and 28 valid, but is reversed as to that patent in so far as it holds Claims 2, 5, 8 and 9 invalid and so far as it holds apparatus claims 26, 27, 34, 36 and 37 valid and infringed; that the decree in the Lamb Glass Company is affirmed as to the Steimer patent, the Peiler "whittling" patent and the Soubier and Ferngren patents, also as to the Peiler "phase change" patent in so far as it holds Claims 1, 3, 4, 6, 7 and 10 invalid and apparatus claims 18 and 28 valid, but is reversed in so far as it holds Claims 2, 5, 8 and 9 of the patent invalid and apparatus claims 26, 27, 34, 36 and 37 valid and infringed. The costs in the court to be paid by the parties on the basis of two-thirds by the plaintiff and one-third by the defendant in each case.

Peiler's Patent Combination of Operations Sustained

THE Peiler Patent, No. 1655391, covering a so-called needle-plunger device used in feeding molten glass to molds for producing narrowed-necked bottles was held valid on May 5 by the United States Circuit Court of Appeals for the Third Circuit in the patent infringement suit brought by the Hartford-Empire Company against the Hazel-Atlas Glass Company, No. 4414.

The court, in the majority opinion written by Judge Buffington, reviews at length the process of glass blowing, both by hand and by machine. It also considers the prior art and concludes that the patentee made a decided advance in the art. The machine used by the defendant company was held to constitute an infringement of the patent.

OPERATION OF DEVICE

The gist of the Peiler invention, the court held, is "a device which, A, produced a gob preformed in suspension; B, a plunger which stuffed or swelled the gob, while in suspension, to approximate mold shape; C, a device which sheared such shaped gob when suspended." The Peiler feeder, it is stated in describing the advance found over the prior art, "instead of employing a stream of glass which collected in the mold until the desired mold charge had accumulated, cut off a suspended chunk or gob of glass which was preformed during suspension to correspond, to some extent, at least, to the shape of the mold cavity in which it was to be received."

The court, referring to the Peiler paddle device by which the molten glass is forced through an orifice there to be formed into a gob, states that the development of the two devices were progressive steps in a connected and inter-related development of the gob feeding art. The plunger is used, it is said, to provide the means of pulsating the discharge of molten glass through the orifice, the use of which permits the discharge to be accelerated, retarded, or even reversed.

"Now an orifice at the bottom of a container of molten glass was not in itself new; shears were not new; gobs formed to shape; all these in insolated form were old," it is noted. "The suction effect of a plunger and its impelling charging capacity were, of course, old. But the test of the inventive character of this combining, cooperating device is not the nonexistence of its separate elements, but whether any one has previously used them in combination to effect the same functional purposes as the patentee.

"We do not deem it necessary to discuss the patents where plungers are shown or where orifices are shown, or where shears are shown. The art is full of such uses, but neither the practical art in its use, nor the Patent Office, the court below, nor this court, has found anywhere a prior patent or device which embodied Peiler's combination of elements as embodied in the patent in suit, or of those of its sister patent No. 1573742 for the paddle construction."

METHOD OF CONTROL

The defendant's device was held to differ only in the mechanical means used to actuate and control its extruder. "Obviously the compressed air means the defendant uses are but a mechanical and functional equivalent of Peiler's means and an engineering alternative. Valuable inventions are not to be filched by an infringer's

(*Continued on page* 113)

The Glass World and What It Is Doing

News of the Industry

1929 Census of Glass Production Completed

The report of the Bureau of the Census on the glass manufacturing industry of the United States for the year 1929 has been completed and is available in printed form from the Superintendent of Documents, Washington, D. C., at 5 cents a copy. The first section includes all glass production except mirrors, framed and non-framed which are covered in a second section, and does not include establishments engaged primarily in glass beveling, bending, engraving, glass labels, staining and ornamenting glass, cutting glass from purchased blanks, except where such activities are incidental to the manufacture of glass from raw materials.

A preliminary report for the mirror industry was issued on September 4, 1930, and for the glass-manufacturing industry on December 31, 1930. The present report gives complete production statistics in detail for the glass and mirrors industries, together with certain general statistics for all three industries. Additional material, including summary statistics by counties, will be presented in later reports.

The figures given in this final report and the general data and detailed production figures are in the main quite close to those shown in the preliminary report. The total value of glass products reported by states shows Pennsylvania in the lead with production over 81 million dollars in value; West Virginia, second, 48 million; Ohio, third, 39 million; Indiana, fourth, 34 million; Illinois, fifth, 22 million; New York, sixth, 17 million; New Jersey, seventh, 16 million; California, eighth, 9 million; Maryland, ninth, 5 million; Arkansas, Louisiana, Missouri and Texas combined, 13 million; Alabama, Florida, South Carolina, Tennessee, 2 million; Kansas, Massachusetts, Michigan, Minnesota, Rhode Island, 7 million; other states not shown separately, 18 million dollars.

Table No. 5 in this publication gives the number of active and idle furnaces, separated by those using gas and those using other fuel. The number of window and plate glass machines and machines for making pressed and blown ware is also listed.

Table No. 6 shows electric power equipment and purchased energy is also detailed.

Table No. 7 gives data on the average number of wage earners employed during the year compared with the years 1925, 1919, 1914 and 1909. A section is devoted to glass products, except mirrors, made from purchased glass. It shows that in 1929 there were 431 such establishments which turned out products to the value of over 33 million dollars. The section on mirrors covers establishments engaged primarily in making mirrors, both framed and unframed such as pier glasses, mantle mirrors, hall mirrors, mirrors for showcases, automobile mirrors and hand mirrors. It shows 304 establishments in operation during 1929 with a production valued at nearly 32 million dollars.

From Our Oklahoma Correspondent

Okmulgee: The Ball Brothers Glass Company has resumed operations at its Okmulgee plant, with 110 men returning to work. The company manufactures fruit jars, jelly glasses and tumblers, and has a weekly payroll of $2,500. Augmenting the old storage house which holds 500 carloads of glass products, a new warehouse has just been completed which will hold 1,000 carloads of fruit jars, tops, etc. William F. Knollhoff, master mechanic, has been transferred from the Ball Brothers plant at Hillsboro, Ill., and will have charge of the plant operations here. Last year Ball Brothers shipped 10,000 fruit jars from the local warehouse, and company officials contemplate a steady business with excellent prospects for a good fruit crop this year.

Tulsa: The Tulsa Plate Glass Company has moved from 519 East 3rd Street to 218 South Elgin Avenue.

Sapulpa: Hervey Arthur Aldridge, 48, secretary and general sales manager for the Liberty Glass Company of Sapulpa, died in a Dallas hotel May 14, following a brief illness while on a business trip to the Texas city. He had been associated with the Liberty firm for the past 10 years.

Surviving are the widow; one son, Russell, and one daughter, Dorothy, all of the home address.

Blackwell: Robert Ballantine, president of the Hazel-Atlas Glass Company of Oklahoma, operating plants at Blackwell and Ada, was unanimously elected president of the Associated Industries of Oklahoma at the close of the organization's recent annual convention in Tulsa. Mr. Ballantine, who has been engaged in the manufacture of glass products at Blackwell for the past 20 years, his two plants specializing in making food containers, packers' ware and fruit jars and employing 400 persons when operating at full capacity—is an active civic worker, having been president of the Blackwell Chamber of Commerce, president of the Blackwell Rotary Club, member of the school board, member of the Chamber of Commerce board of directors, and director of the National Association of Manufacturers.

Sand Springs: Lewis Barnett, 51, vice-president and general sales manager for the Kerr Glass Company of Sand Springs, recently died in a St. Louis hospital following an illness of two months.

Mr. Barnett, who was identified with the glass industry for many years, was born in Bainbridge, Ga. More than 20 years ago, he lived for a time in Chicago and Detroit, later moving to Portland, Ore., and came here when the Kerr Glass Company moved from that city to Sand Springs, 15 years ago. He became associated with the late Alexander Kerr 27 years ago in Chicago.

Mr. Barnett is survived by the widow; three sons, Henry, Adolph and David, of the home address; one daughter, Muriel, now studying dancing in Germany; one brother, Herbert, of Tulsa, and two sisters, Mrs. Sebastian Messher of Chicago, and Mrs. Sadie Freedman of New York City.

Mr. Cruikshank Still Enjoying His Stay in Tahiti

A note to F. W. Preston, consulting glass technologist, Butler, Pa., from J. W. Cruikshank, former Pittsburgh glass-works consulting engineer, now in Tahiti in the South Seas, includes the following:

"It is hot here with a good deal of rain; today it feels like an orchid hothouse, as I am not at all energetic.

"I have a nice house right on the lagoon that originally belonged to Keable, the author.

"Most of my time goes in swimming and sailing, some gardening and photography.

"The mail comes in tomorrow (Feb. 27, 1932), the great monthly event which brings us in touch with the outside world."

Construction News

F. W. Dodge Corporation reports that of the thirteen districts comprising the thirty-seven states east of the Rockies all but three showed higher construction contract totals in April than in March. April contract totals for the entire eastern area showed an 8% gain over March, in contrast to a loss of 9% between the corresponding two months of 1931. But only slight encouragement is offered by the current pick-up since analysis discloses the gain was entirely due to public works, especially highways.

Modest Gain in April Plate Glass Production

The total production of Polished Plate Glass by the member companies of the Plate Glass Manufacturers Association for the month of April 1932 was 5,025,008 square feet as compared to 4,414,464 square feet produced by the same companies in the preceding month, March 1932, and 8,920,151 square feet produced by the Association members in the corresponding month last year, April, 1931.

The Glass Lined Tank Company of Bellaire, Ohio, has been incorporated in that state by Charles Kapner, Ben Kapner and Clifford L. Belt. It is stated that the new corporation is to be the selling organization of the Bellaire Enamel Company.

R. & H. News

It was recently announced by the Roessler & Hasslacher Chemical Company, Inc., that the Pacific Roessler & Hasslacher Chemical Corporation (a subsidiary of the parent company), El Monte, Cal., had elected C. K. Davis, chairman of the board, Dr. E. A. Rykenboer, president, F. S. Pratt, vice-president, A. Frankel, treasurer, H. A. Schumacher, assistant treasurer, L. Rice, secretary and J. L. Fahs, assistant secretary.

Industrial Cleanliness Awards

The Cleanliness Institute, 45 East 17th Street, New York, is offering cash awards of $25 each for details of the best plans of cleanliness education and training now in operation in the industrial fields. The Institute has found that efforts to raise the standards observed by employes in specific instances have resulted in profit to both employer and employe.

The American Housewares Exhibit

A wholesale market for house furnishings will be held at the Hotel Pennsylvania, New York, July 24-30. The exhibit is held at this time to give the manufacturers an opportunity of receiving orders from retailers and filling them in time to have the merchandise ready in the store for Fall openings.

The Glenshaw Glass Company, Inc., Glenshaw, Pa., lost a second of their warehouses by fire about midnight May 26. About six weeks previous they were visited by a similar catastrophe with the result that their storage space is much curtailed. The destroyed stock, however, is being duplicated rapidly and they expect to have little or no delay in getting orders out promptly.

An Outline of the Technology of Glass abstracted from an article by James S. Morgan in *Glass*, December, 1931, and reprinted by the American Potash and Chemical Corporation, New York. Copies are available upon request.

The Westinghouse-Neon Company has opened a plant at Hamilton, Ontario, to manufacture neon tubing. Nine other American plants in various lines have also arranged recently for production facilities in Canada.

John W. Hobbs, president of the Consolidated Plate Glass Company of Canada, which dominates the industry there, was recently elected to be a director of the Canadian Pacific Railway Company.

Peiler Patent

(*Continued from page* 109)

use of optional, alternative forms which in the end effect the same plunger movement, which is the same in Peiler's and the defendant's device." The court reversed the decree below which held there was no infringement.

The majority refused to follow the opinion of the Chancery Division of the High Court of Justice as to the validity and infringement of the patentee's British patent.

Judge Woolley dissented from the conclusion of the majority. "Between the time of man-blowing methods and the patent in suit there were at least 15 patents covering a glass bath in which a reciprocating plunger operated to accelerate and retard the flow of molten glass through an orifice and, in some cases, to form a gob suspending from the orifice, then to be cut off and transferred to a bottle mold," he states in his dissenting opinion. "These elements constitute the main structure of the apparatus of the patent and embody its primary function. In adopting and combining them, Peiler, so far, did nothing even remotely inventive. He simply took them and used them as he had found them."

He also points out that "the only shaping of the gob by the defendant's machine is that effected by a false ring, positioned many inches below the orifice and shears, through which the gob after it has been severed from the orifice drops on its way to the mold. This shaping, such as it may be, is by an altogether different means in an altogether different place from the shaping means and place of the patent."

The claims of the patent are either invalid or not infringed, Judge Woolley concluded.—*United States Daily, May 7, 1932.*

Performance talks

"Our Brickwork Now Gives Us Twice as Much Service"

Alexander H. Kerr & Co., Inc., Sand Springs, Okla., Mfrs. of glass jars, bottles, etc., write:

"We lay up our ports in Setskold, and also paint the brick work around the ports with Setskold. When patching our regenerators and the fire boxes in our lehrs we use your product exclusively, and find that the brick work gives us twice as much service without repairs as brick work that was formerly laid up without Setskold. The use of Setskold has become a regular part of our repair routine and we recommend it highly."

Setskold is a high temperature refractory mortar. It air sets, and has great bonding strength. Use it for laying up the fire brick in ports and port necks; for laying up the refractory blocks which form the port floors or covers; and as a wash either outside or inside the regenerator walls, to prevent air leakage.

In 100, 250 and 500 pound airtight steel drums. Order a trial drum today.

LACLEDE-CHRISTY, ST. LOUIS, U. S. A.

P-5

SETSKOLD

Air-Setting Refractory Mortar

A LACLEDE-CHRISTY PRODUCT

Current Prices of Glass-Making Materials

May 20, 1932

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	..	.32
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	5.50	..
Tartaric	lb.	..	.24
Alcohol, denatured	gal.	..	..
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb.	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.15½
Ammonia water (NH_4OH) 26° drums	lb.	..	..
Antimony, metallic (Sb)	lb.	.02½	.02¾
Antimony oxide (Sb_2O_3)	lb.	..	.09¾
Antimony sulphide (Sb_2S_3)	lb.	..	.08½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.14 .04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	47.00	..
90% through 100 mesh	ton	44.00	..
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05¼
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	..	.07¼
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	15.00-16.00	18.00
Bone ash	carlots, lb	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	..	.02¼-.02¾
Granulated	lb	.02-.02½	.02¼-.02¾
Powdered	lb.	.02¼-.02¾	..
Boric acid (H_3BO_3)	lb	.04¼-.05¼	..
Cadmium sulphide (CdS)—			
Red	lb.	..	.65-.90
Orange	lb.	..	.60-1.10
Yellow	lb.	..	1.30-1.50
Chromium oxide (Cr_2O_3)	lb.	..	.20
Cobalt oxide (Co_2O_3)			
In bbls.	lb	..	1.25-1.35
In 10 lb. tins	lb	..	1.35
Copper oxide			
Red (Cu_2O)	lb	..	.25
Black (CuO)	lb.	..	.17-.19
Black prepared	lb	..	.22
Cryolite ($Na_3Al F_6$) Natural Greenland			
Kryolith)	lb	.09	.09¼
Synthetic (Artificial)	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb		..	1.15-1.20
*Feldspar—			
100 mesh	ton	11.50-17.50	12.00-18.00
80 mesh	ton	11.00-11.50	13.00
40 mesh	ton	10.75-11.00	12.00
20 mesh	ton	9.50-11.00	..
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	30.00	..
In bags or barrels	ton	34.00	39.00
Imported	ton	30.00-31.00	33.00-37.00
Formaldehyde	lb	..	.07
Graphite (C)	lb	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb	..	.0425
Black (FeO)	lb	.04½	..
Kaolin (f.o.b. mine)	ton	8.00-9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00

*Spot Shipments.

		Carlots	Less Carlots
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb	..	.30
Lead oxide (Pb_3O_4) (red lead)	lb.	.0550	.0675
Litharge (PbO)	lb.	.0450	.0575
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	5.50	..
Burnt (CaO) ground, in bulk	ton	5.00	..
Burnt, ground, in paper sacks	ton	7.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl	2.15	..
Limestone ($CaCO_3$)		1.50-2.50	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb	.06	.07
light (in bbls.)	lb	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb	.06	.10
Manganese 85% (MnO_2)	lb	.03	.03
Nickel oxide (Ni_2O_3), black— for nickel content	lb	..	.35
Nickel monoxide (NiO), green— for nickel content	lb	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb	.09	.09¼
Ground	lb	.11	.12
Potassium carbonate—94-96%	lb.	.0555	.0555
Calcined (K_2CO_3) 96-98%	lb	.06¼	.07
Hydrated 80-85%	lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4)	lb.	..	.25
Potassium hydrate (KOH) (caustic potash)	lb	.07⅛	.08
Potassium nitrate (KNO_3) (gran.)	lb	..	.06-.06¼
Potassium permanganate ($KMnO_4$)	lb	.16½	.17½
Powdered blue	lb.	..	1.35
Rochelle salts, bbls.	lb.	..	.15
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb	..	1.70
Silver nitrate ($AgNO_3$) (100 oz.)	per oz	..	.21¾
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb	1.05	..
In barrels	Per 100 lb	1.38	1.90-2.13
In bags	Per 100 lb	1.17½	1.72½-1.92½
Spot orders .025 per 100 lbs. higher		..	..
Sodium bichromate ($Na_2Cr_2O_7$)	lb	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb	2.50	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	..	..
95 per cent	Per 100 lb	1.67-177	1.72-1.82
Sodium selenite (Na_2SeO_3)	lb	..	2.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.05½	.06
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50-1.55
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb	3.45	3.80-4.00
Flowers, in bags	Per 100 lb	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb	.37½	.39
Tin oxide (SnO_2) in bbls.	lb	.28	.29½
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	..	2.75
Yellow	lb	..	1.50
Zinc oxide (ZnO)	lb	.08½	.12
American process. Bags	lb	.05¾	.06
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to April 24, 1932.

	March 1931 Quantity	March 1931 Value	March 1932 Quantity	March 1932 Value	Three Months Ending March 1931 Quantity	Three Months Ending March 1931 Value	Three Months Ending March 1932 Quantity	Three Months Ending March 1932 Value
Glass and glass products (Total)	.....	$822,273	.....	$397,122	.....	$2,104,019	.....	$1,171,107
Plate and window glass—								
Window glass, common, box 50 sq. ft.	973	5,624	130	864	2,302	12,386	506	2,959
Plate glass, unsilvered, sq. ft.	444,411	144,801	252,165	72,558	1,224,960	373,811	1,084,304	294,723
Other window and plate glass lbs.	224,656	38,548	128,683	10,556	898,120	98,120	422,723	44,615
Glass containers (bottles, vials and jars)	.....	233,062	.....	118,027	.....	586,760	.....	276,352
Table glassware, plain	.....	100,497	.....	51,405	.....	244,522	.....	120,712
Table and other glassware, cut or engraved	.....	11,167	.....	5,186	.....	19,068	.....	13,153
Lamp chimneys and lantern globes lbs.	.....	8,399	.....	6,774	.....	30,439	.....	16,461
Globes and shades for lighting fixtures lbs.	.....	49,643	.....	18,856	.....	122,429	.....	54,090
Chemical glassware lbs.	12,985	12,044	11,613	12,370	37,643	38,416	27,217	28,007
Electrical glassware, except for lighting lbs.	146,555	11,268	6,823	669	391,843	31,907	274,537	11,160
Other glassware	.....	207,220	.....	99,857	.....	546,161	.....	308,875

IMPORTS

Corrected to April 24, 1932.

Glass and glass products	.....	$581,353	.....	$233,865	.....	$1,546 089	.....	$857,254
Cylinder, crown, and sheet—								
Plain	dut. lb.	979,975	44,695	258,243	9,134	2,958,289	117,464	627,240	23,981
Bent, beveled, colored, etc.	dut. lb.	281,926	34,447	41,698	13,054	607,458	75,891	209,854	41,555
Plate glass	dut. sq. ft.	446,773	136,456	48,794	8,904	1,254,031	363,518	508,648	87,396
Glass mirrors		236	447	190	204	428	834	672	1,574
Rolled, cylinder, crown, and sheet glass, ground, obscured, bent, beveled, colored, etc.	.....	1,910	.....	2,727	.....	11,428	.....	33,882
Laminated glass and manufactures, and plated glass	.....	2 420	.....	20	.....	3,716	.....	2,934
Bottles, vials, jars, and other containers	.....	61.184	.....	28.242	.....	141,941	.....	74,463
Scientific articles and utensils	dut.	29,838	.....	19,340	.....	85,089	.....	62,929
Tubes and rods	dut.	14 701	.....	9,226	.....	32,290	.....	19,060
Illuminating articles	dut.	27,284	.....	9,558	.....	94,672	.....	53,028
Blown glass articles—								
Bulbs for electric lamps, without filament	dut.	1,532,715	14,164	1,462,087	12,078	4,104,787	38,084	3,680,868	29,647
Other blown glass articles	dut.	.....	127,450	.....	64.162	.....	356,345	.....	244,425
Pressed glass articles		.....	14,099	.....	9,080	.....	35,903	.....	28,787
Other glassware		.....	72,158	.....	48,136	.....	188,914	.....	153,593